Let's start in our own backyard: Children's engagement with science through the natural environment

By Athalie Alexander and Sharon Russo

Capitalising on areas in which teachers feel most comfortable, the teaching of Biology, environmental education or nature to young children can be an alternative way of introducing and understanding Science. A *Citizen Science* program currently being run by the University of South Australia (UniSA) may be an appropriate starting point. *Citizen Science* is research involving interested members of the public, including school groups and parents, who participate by collecting scientific data in collaboration with scientists and professional bodies. Following the success of two previous projects, *Operation Possum* and *Operation Bluetongue*, the 2009 venture of *Operation Magpie* encouraged interested participants to access a website, where information was provided regarding magpie behaviour and bird watching. This paper reports on a series of lessons developed from the program to encourage teachers and students to understand how better to interact with wildlife in their backyards (UniSA 2009).

This paper examines the responses, perceptions and participation levels of 22 children, aged six to seven years, involved in a targeted school program about science and the natural environment. Adopting the role of participant observer, the researcher introduced scientific concepts by adapting lesson plans about birds and the natural environment, based on the *Operation Magpie Citizen Science* project. Five teachers were also interviewed about their perceptions of science teaching and the value of this type of program. Citizen science involves professional researchers working with interested members of the public. Encouraging teachers', children's and parents' interest in science and the natural environment by integrating science concepts across the early childhood curriculum will raise the profile of primary science.

Introduction

Holistic and heart-driven … impregnated with spirit and compassion. This may sound like a book review for the latest best-seller but is, instead, a call to make science more creative, exciting and successful for students (Bekoff, 2000, p. 635). While this may be easier said than done, considering the state of primary science teaching in Australia (Goodrum, Hackling & Rennie, 2001; Tytler, 2007), guiding early childhood students to a deeper science understanding is a key focus of this paper. Research and debate regarding strategies such as improving educators' skills and confidence, changing parental attitudes and modifying curricula, in order to raise the profile of science and to reinvigorate interest in the teaching of science in Australian primary schools, has been extensive, if not exhaustive (Colvill, 2003; Goodrum et al., 2001; Tytler, 2007).

Moving Ahead

All may not be lost, however, as there are some educators who are keen to include science in their program, but are uncertain about where to begin (Conezio & French, 2002). The answer, then, may be to look back in order to move forward, and to consider the value of 'nature study'. Capitalising on areas in which teachers feel most comfortable, the teaching of biology, or environmental education, or nature study to young children can be one way of introducing an understanding of Science, with a view to encouraging positive attitudes in children through their emotional ties with the Earth, resulting in a lifelong appreciation (Rule, 2007). In junior primary years (ages five to eight), students typically have an abundant curiosity and are eager to learn (Allen & Marotz, 2003; Gallenstein, 2003). Environmental education encourages children's curiosity and desire to understand their world, and to learn respect for the environment (Bower, 1998; Wilson, 2008). If children are not given these opportunities to learn about and connect with the natural world, future generations of citizens may not understand, or be able to make informed decisions about, their environmental impact (Harlen & Qualter, 2009).

Observing plants and animals in their own backyard or local parks and being involved in outdoor activities will help to promote children's naturalistic intelligence (Wilson, 2008), and are pursuits that can be facilitated by parents. This study relates to children's connections with science and nature through the school curriculum, but it is also important to have the support of the children's families, because the most effective education programs include positive parental involvement and support on the home front (Ersoy, 2007; Riley, San Jaun, Klinkner & Ramminger, 2008).

Citizen Science

One such initiative, in which families can become involved, is a project called *Operation Magpie*, designed by the University of South Australia (UniSA). Since 2007, citizen science programs have been successfully conducted by the Barbara Hardy Centre for Sustainable Urban Environments, one of the University's important research centres (UniSA, 2009a). Citizen science is a research methodology in which

professional researchers work with interested members of the public, including school groups and parents, who participate by collecting data within a cooperative framework of research and education (Cooper, Dickinson, Phillips & Bonney, 2007). Although community environmental monitoring is not an innovation, citizen science has become an increasingly popular method of data collection in Australia (Sullivan, 2009). Tytler (2007) recommends that science in schools should be more connected with the wider community, and citizen science is one way of effecting such a change. When running any community or citizen science project, children should be encouraged to participate from the planning stages. This involvement empowers children, as they have the important task of gathering and providing real scientific data, which the professional organising body might not otherwise have been able to obtain (Hart, 1997).

It is important to feel a sense of belonging to one's own community and environment (Berk, 2006; Hart, 1997). Enabling and encouraging students to fully experience their natural environment should enhance their overall learning and make a difference to their world (Bower, 1998; Rule, 2007). This type of respectful and supportive relationship can empower students through increasing self-esteem, enabling them to comfortably question discoveries, offer ideas and opinions and reflect on experiences (Zins, Weissberg, Wang & Walberg, 2004).

Learning Focus

With the environment forming a base for science learning, an ideal progression could be one of using science at the centre of the curriculum to enhance other learning areas such as literacy, rather than vice versa. In schools where a science-based curriculum has been developed, students' engagement has improved significantly through the problem-solving aspect of learning, which incorporates and promotes language skills. Rather than an activity that needs to be slotted into the weekly timetable, science can encourage children's higher level thinking across all subject areas (Conezio & French, 2002). Young children develop ideas about the world from their own learning experiences, so curriculum integration and inquiry learning enables teachers to successfully implement appropriate, play-based activities that enable students to pursue their own learning in their own way (Conezio & French, 2002; Krogh & Morehouse, 2008). Inquiry-based learning is the very essence of science teaching (Fleer, Jane & Hardy, 2007). It is a philosophy that encourages children's confidence and ability to think and communicate effectively and ultimately to become caring and responsible members of society (International Baccalaureate Organisation, 2007). This learning focus guided the researcher during the project.

Research Questions

The study sought to ascertain in what ways, if any, children and teachers benefit from targeted programs about the environment. Specifically, the teachers' and children's ideas about the environment were investigated and the materials and information presented were assessed.

Methodology

A qualitative study was undertaken, comprising interviews with teachers and children, together with analyses of work samples and observations of the children participating in lessons about magpies, other birds and the environment. The researcher adopted the role of participant observer for the introduction of a series of lessons to children and observations of their responses.

Sample

Early-childhood participants in the project were drawn from a convenience sample in a middle-class, government-run, primary school in suburban Adelaide, South Australia. The 22 children from a Year 1 class, in their second year of schooling, comprised eight girls and 14 boys aged between 6.4 and 7.2 years. Five female primary school educators, whose teaching experience ranged from one year to over 30 years, also took part in the study.

Implementation

Over a four-week period the researcher carried out a unit of work which related to the environment, and specifically to magpies and other birds within the school grounds. The lessons were adapted from the *Operation Magpie Citizen Science* program, developed by members of the UniSA faculty for the primary and middle years, which encompass students aged approximately 8 to 14 years, in Years 3 to 9 (typically the 4th to 10th years of schooling).

Lesson 1

The first lesson was a walking excursion around the school grounds. This experience introduced to the students the idea of observation of their environment generally, and local birds in particular.

Lesson 2

A subsequent lesson required the class to draw a magpie or other familiar bird without any reference sources.

Lesson 3

The children labelled the main parts of the bird they had drawn.

Lesson 4

In a group situation in class the researcher introduced selected components of a bird kit hired from a local organisation that supports students' learning by providing resources to enable direct contact with animals, plants and their habitats. Included in the kit were preserved whole birds and body parts, eggs, nests, books, posters and other reference material. The kit was then displayed in the classroom, offering students sensory experiences using the exhibits, as well as access to the written material.

Some children took advantage of the resources and carried out additional work at school and at home, with one student writing a poem about a magpie and another compiling a list of bird facts found in a book at home.

Lesson 5

Another learning experience was an alternative depiction of a bird, where the children did not know what they were drawing. This was a literacy-based exercise in which the researcher gave step-by-step verbal instructions, such as 'draw a circle' (to represent a bird's head). The instructions were interpreted differently by each student, who chose their own

Photo 1: A backyard bird kit used.

drawing materials and colours and completed their individual pieces using glue guns to attach googly eyes and coloured feathers, resulting in a diverse array of abstract artworks.

Further lessons included Indigenous perspectives, reading of factual and fictional stories about birds and the environment, poetry and children's writing about their learning. The unit culminated in a whole-school assembly presentation, at which the class explained the unit of work undertaken by reading extracts from their writing and displaying their bird art pieces.

Materials and Data Analysis

The researcher recorded children's work samples and observed their responses to the unit of work on birds and the environment. A simple ranking scale was prepared by the researcher to record observations of the 22 early childhood students' responses to the lessons. An observation checklist, in table format, listed students' participation levels during discussions, their understanding of topics covered through work samples, their sustained interest in the lessons and related resources, and their extended engagement level. A ranking scale of 'poor', 'good' or 'excellent' was assigned to each student against a set of described indicators, and these data were tabulated and summarised (Table 1).

Interviews

A series of interviews also took place up to six weeks after completion of the lessons. A pro forma was prepared to record students' responses to four interview questions relating to their perceptions of the environment, new areas of learning during the project, and preference and non-preference for the lessons and activities carried out. The interview with each student began with informal conversation, which included advising the child of the intended proceedings and seeking the child's consent to participate. A structured interview ensued, and the researcher recorded each participant's responses on the interview pro forma. A frequency count of the students' responses was categorised and summarised, using key words and phrases, to ascertain patterns of responses.

OBSERVATION	RANKING					
	POOR		GOOD		EXCELLENT	
	INDICATORS	NO.	INDICATORS	NO.	INDICATORS	NO.
Participation level during discussions	Not actively involved in discussions	1	Willingness to be involved in discussions Sometimes makes suggestions or observations	13	Regularly participates in discussions Always keen to contribute information	8
Work samples indicate understanding of topics covered	Lack of content Rushed or incomplete work	3	Usually provides a variety of written information about the topic Adequate content	13	Regularly completes extra work on the topic Quality and content good	6
Sustained interest in lessons/activities/ resources	Short attention span May display interest in items unrelated to task	3	Understands task requirements Follows instructions and suggestions Displays concentration Usually completes task	12	Understands task requirements Makes suggestions for improvements Works collaboratively and autonomously Completes work	7
Extended engagement level (seeks/offers further information)	Little discussion with others No additional research undertaken	10	Discusses topic with peers Sometimes questions teacher	6	Discusses topic with peers Regularly questions teacher Undertakes additional individual research	6

Table 1: Summary of 22 early childhood students' responses to environment lessons. Ranking lists the number (No.) of individual students against described indicators.

Photo 2: Children's drawings of birds.

The questions asked of the children were:

Can you tell me what the environment means to you?

Can you tell me about any new things that you have learnt during the activities we have just done?

What did you like most about the activities?

Was there anything you didn't like about the activities?

Participating educators were also interviewed by the researcher, and their responses were recorded on an interview checklist with seven questions. The questions related to the teachers' ideas about the environment, their philosophy and history regarding teaching of science and environment lessons and their participation in, and knowledge of, citizen science projects. Interview responses by participating educators were also categorised.

Specifically, the teachers were asked:

What does the environment mean to you?

Do you conduct lessons about the environment?

Do you conduct science lessons?

Have you ever been involved with a citizen science project?

Were you familiar with the 'Operation Magpie' project prior to being involved in this research?

Would you now implement 'Operation Magpie' or a similar program with your class?

At the conclusion of each interview the teachers were given additional printed information relating to the *Operation Magpie* program, which also referred them to the available online resources (UniSA, 2009b).

Results

Table 1 lists student responses to the experiences. The majority of students' participation levels, work samples and sustained interest are rated as 'excellent' or 'good'. The category of extended engagement, through seeking or offering further information, was not as well rated, with almost half of the participants falling into the 'poor' category. In relation to the students' interview questions, all 22 children described the environment in positive terms, with eight giving affective responses such as the environment being 'special' or 'good'. Eight children also referred generally to flora or fauna, and six specifically mentioned birds.

In terms of what new things the children had learnt, most responses related to birds (14), followed by the environment generally (4) and the tallying and graphing exercises (4). Favourite experiences were the outdoor observation and recording of birds (12), learning about the preserved birds (6) and drawing birds (4). Sixteen of the 22 respondents liked all the experiences undertaken, with six offering suggestions for improvement.

The five participating educators offered similar answers regarding the environment. All gave positive responses, expressing how the environment was important to them, both personally and professionally. All claimed that they conducted science and environment lessons, albeit only once per week or as an ad hoc unit of work on a specific topic or theme. This was justified by comments such as *it was easier to collect materials and prepare resources to carry out science lessons in blocks of time*. Science was seen as requiring considerable planning, and experiments were difficult to set up, often involving 'messy' elements. These views are consistent with the findings of Conezio and French (2002). There were various science curriculum approaches and content, including water, solar systems, light, colour, textiles and the weather. Only one teacher regularly took her class outdoors to conduct lessons, which were not necessarily related to science or nature.

There was consensus amongst the teachers that they should conduct more science lessons, but also a general concern about the lack of available time and space in the curriculum to effectively maintain science and environmental activities. They suggested that additional resources, such as those provided for *Operation Magpie*, would increase their motivation for science teaching. All the teachers were interested and happy to be informed about *Operation Magpie* and appreciated the idea that a complete science unit was prepared, freely available and ready to teach.

Discussion

Guiding early childhood students into a deeper science understanding was a focus of this research, with the objective of ascertaining whether children and teachers benefited from targeted programs about the environment. The project specifically asked whether materials and information presented in a citizen science program such as *Operation Magpie* would assist educators in their teaching, and would promote children's learning about science through the natural environment. The study showed that the early childhood students demonstrated an awareness of, and interest in, the world around them. However, even though they did display engagement with the natural environment, their understanding of scientific concepts was not generally well developed.

Young children display a great wonder about the natural world, and particularly about other living things (Wilson, 2008). Accordingly, the students were fascinated with the preserved birds and bird parts, prompting such questions as *Where did you get those dead birds?* and *Who killed the birds?* Exploring questions, encouraging discussion, drawing and writing assists students to engage with science in a social atmosphere, where they are more likely to communicate their discoveries if the context is meaningful (Gallenstein, 2003; Harlen & Qualter, 2009). While children sat at their desks labelling their bird drawings, one girl asked *Do birds have ears?*, which prompted further conversation regarding how the class might research this question. Another student talked about holding the *scary-looking owl with sharp claws*.

After discovering a crested pigeon in the schoolyard habitat, a six-year-old boy coined the term 'rhino bird', because of what appeared to be a rhinoceros-like horn on the bird's head.

These and other discussions and ideas from the children confirmed that their prior knowledge and understanding of scientific concepts differed widely (Fleer et al., 2007; Lind, 2005).

Preschoolers learn about maths and science concepts through play, but if their natural curiosity and eagerness to learn has not been extended by parents or educators, children will not all have the same understanding about learning and applying these skills when they arrive at school (Lind 2005). There was discussion with the students regarding the *Operation Magpie Citizen Science* program and its connection with the lessons and activities they had been undertaking. While many children did report seeing magpies and other birds in their home and community environments during the research period, it was their families who would be supporting the continuation of these observations and facilitating follow-up activities in their own backyard. The idea of *building on the familiar' through incorporating students* interests and knowledge in the classroom (McNaughton, cited in Hill 2006, p. 63) also extends to the family supporting children's school interests in the home environment. This connectedness between school and home can also contribute to students' engagement (Zins et al., 2004).

It may be that the researcher did not recognise or maximise opportunities to do this because of the time restrictions of the curriculum (Reynolds, 2009), another point raised by participating teachers.

The researcher attended a preliminary training session conducted by the *Operation Magpie* developers prior to undertaking this project, at which resources and ideas were presented to interested teachers. One early childhood educator expressed concern about whether she could use the material because it was aimed at upper-primary children. Learning to appropriately adapt the curriculum is a very important skill for all educators (Ashman & Elkins, 2005) and one that was essential for this study. Based on the classroom context and developmental level of the students, it was necessary to make choices about the most appropriate inclusions and exclusions (Smith & Lovat, 2003).

Conclusion

Using the environment as a base for science, and science as the base for further teaching and learning, this project successfully incorporated mathematics, literacy, society and the environment, Indigenous perspectives, visual and performing arts, design and technology and health and physical education, supporting the integrated curriculum approach and encouraging higher-level thinking across all subject areas (Conezio & French, 2002; Krogh & Morehouse, 2008). Through introducing basic scientific concepts and adapting lesson plans for early childhood students, materials developed for the *Operation Magpie Citizen Science* program were successfully utilised. The project revealed that both students and teachers had positive perceptions of the natural environment and that the children generally displayed an understanding of and a sustained interest in the activities undertaken. Teachers believed that ongoing resources and professional development were required to motivate and support the teaching of science in primary schools.

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Example of sheet used by children to graph bird data

BIRD SIGHTINGS IN SCHOOL GROUNDS

Name: **Date:**

TYPE OF BIRD		HOW MANY BIRDS
Magpie		
Parrot		
Noisy Miner		
Swallow		
Crested Pigeon		
Galah		

Example of sheet used by children to graph bird data

Bird Sightings in School Grounds

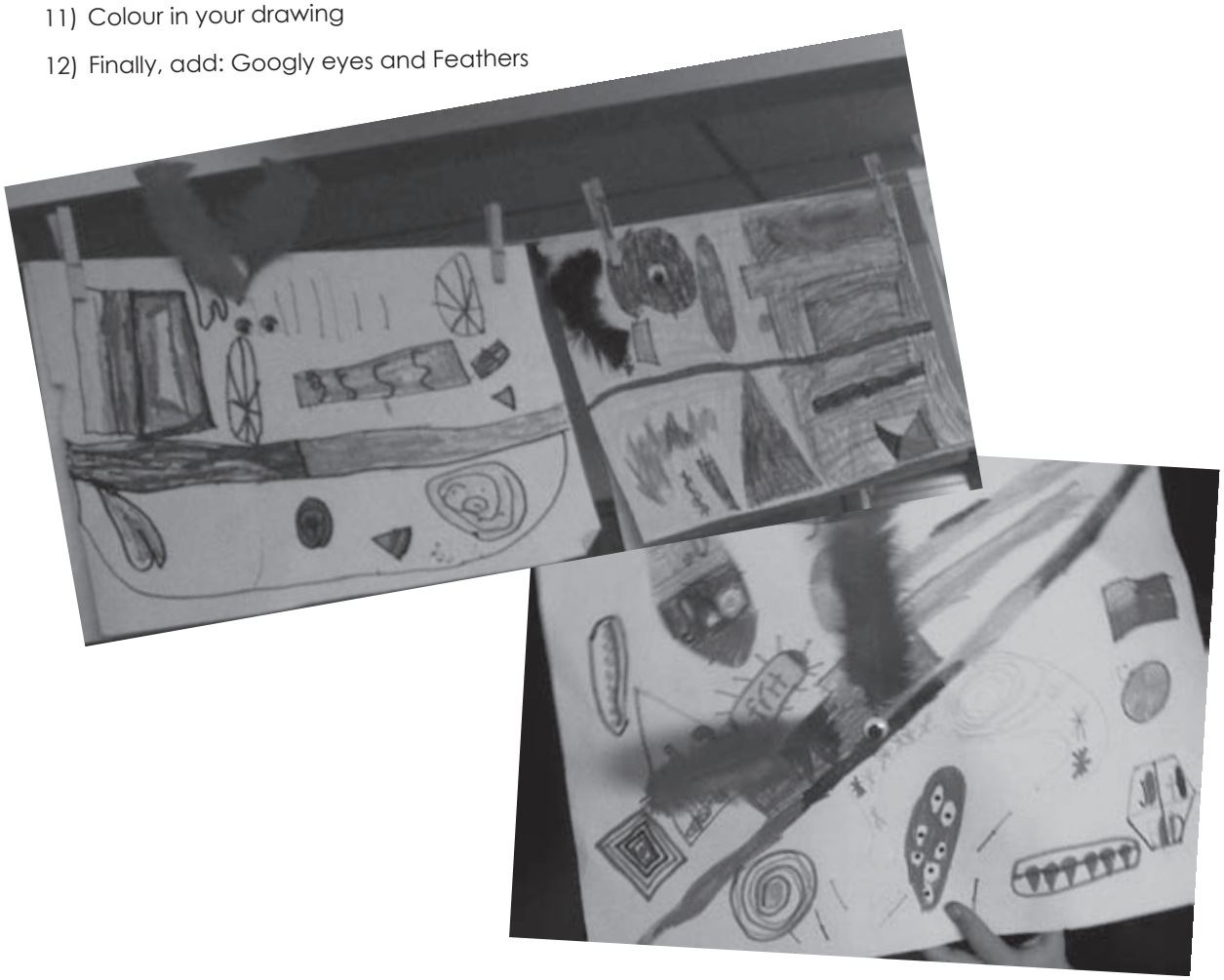
Name: Date:

20+						
19						
18						
17						
16						
15						
14						
13						
12						
11						
10						
9						
8						
7						
6						
5						
4						
3						
2						
1						
	Magpie	Parrot	Noisy Miner	Swallow	Crested Pigeon	Galah
						

Instructions for mystery abstract drawing

Ask the students to follow the steps below and sketch using lead pencil, coloured pencils or crayons

1) Draw a line from one side of the paper to the other
2) Draw another line, close to the first line, from one side of the paper to the other
3) Colour in the space between the lines to make a thick line
4) Draw a curved line touching the line that is already on the paper
5) Draw a circle, any size, anywhere on the page
6) Draw an oval shape, any size, anywhere on the page
7) Draw a triangle, any size, anywhere on the page
8) Draw two long rectangles
9) Draw six short lines
10) Draw three more shapes anywhere on the page
11) Colour in your drawing
12) Finally, add: Googly eyes and Feathers



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